INSTRUCTION MANUAL

Mega-Node

KAY ELECTRIC COMPANY

PINE BROOK, NEW JERSEY

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CApital 6-4000

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Figure 1, **MEGA-NODE,** *240A*

SECTION I
GENERAL DESCRIPTION

A. DESCRIPTION.

The **MEGA-NODE** (NOise dioDE) is a calibrated random noise source, providing a selection of several output impedances with a choice of either balanced or unbalanced output. It may be used for the rapid measurement of receiver gain, or noise figure and for the indirect calibration of standard signal sources. The noise figure, defined as the ratio of the noise power in a practical system to the noise power in an ideal system, may be read directly from the meter of the **MEGA-NODE.**

Comparative receiver sensitivity measurements may be made with the **MEGA-NODE** unless the circuit bandwidth is unknown or excessive circuit noise is encountered. When used with an amplifier with known passband and gain, the **MEGA-NODE** may be employed to standardize the output of signal generators. This is a valuable application, because of the tolerances encountered in high frequency attenuators.

B. FEATURES.

The **MEGA-NODE** employs a noise diode with a tungsten filament as a temperature-limited fluctuation noise generator. The plate and filament voltages for the diode are d-c, supplied from two separate voltage regulated selenium-bridge rectifiers, thus minimizing hum modulation of noise power.

The diode current, which is proportioned to noise power output, is adjusted by the level control on the front panel. This current is indicated by a front panel meter, calibrated to read the noise figure in db.

Several output resistance values, selectable by a front panel switch, are provided for either balanced or unbalanced type output. The output resistance selector switch also indicates the correction value in db to be added to the meter reading where output impedances other than nominal 50 ohms unbalanced are employed. An inductor in shunt with the output is controlled by a panel switch.

The output circuit has been carefully designed for low VSWR at the output terminal over the usable frequency range. The output connectors are BNC type UG-290/U fittings. Adapters are provided so that either coaxial or twin-lead connecting cables may be used.

C. SPECIFICATIONS.

Frequency Range: 5 to 220 mc.

Output Impedances:
Unbalanced - 50, 75, 150, 300 ohms, Infinity
Balanced - 100, 150, 300, 600 ohms, Infinity

Noise Figure Range:
0 to 17 db at nominal 50 ohms
0 to 24.8 db at 300 ohms

Meter Calibration:
Linear in d-c ma.
Logarithmic in db noise figure.

Tube: Sylvania type 5722 tungsten filament diode.

Power Supply: Input approx. 50 watts, 117-V (±10%), 60 cps a-c. (Available for 50 cps operation on special order.)

Dimensions: *Model 240A,* 9½" x 17½" x 9".
Model 240B, 19¼" x 10¼" x 9½".

Weight: 28 lbs.

Fuse Protection: One type 3AG, 1 amp. A six foot line cord is supplied with stowage space at the rear of the chassis inside the cabinet.

D. ACCESSORIES SUPPLIED.

Balanced Output: 1 adapter, coaxial fittings to twin lead

Unbalanced Output: 1 adapter, coaxial fittings to unbalanced pair.

1 Instruction Manual.

E. ASSOCIATED EQUIPMENT REQUIRED.

1. Power level measuring device (square law r-f voltmeter, thermocouple power meter or bolometer power meter.) See *fig. 2.*

or

A.C. voltmeter (whose law is unknown) plus a 3 db pad with a switching arrangement to select the pad as desired. See *fig. 3.*

or

Any A.C. voltmeter and detector, for relative measurements of noise. See *fig. 4.*

or

A vacuum tube voltmeter and log-log graph paper for performing noise figure measurements at or near maximum output capabilities of the **MEGA-NODE**.

2. Low noise amplifier, where device under test has insufficient output to deflect a power level indicator.

3. Hum filter (60 or 120 cps), bridge type.

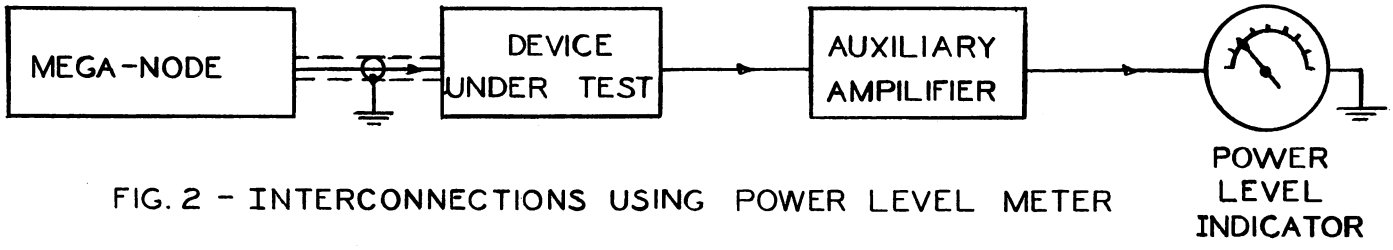


FIG. 2 - INTERCONNECTIONS USING POWER LEVEL METER

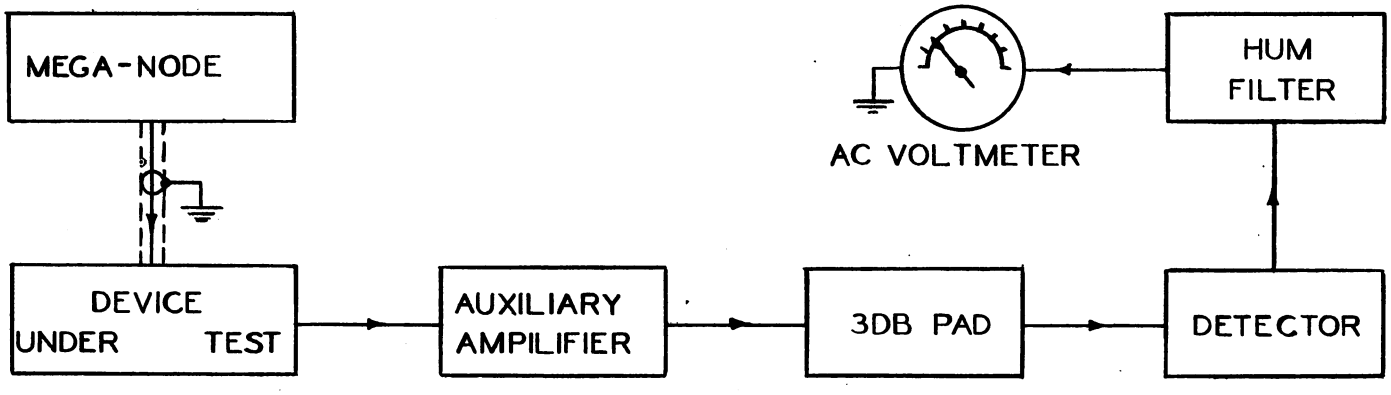


FIG. 3 - INTERCONNECTIONS USING AC VOLTMETER (FOR UNKNOWN LAW)

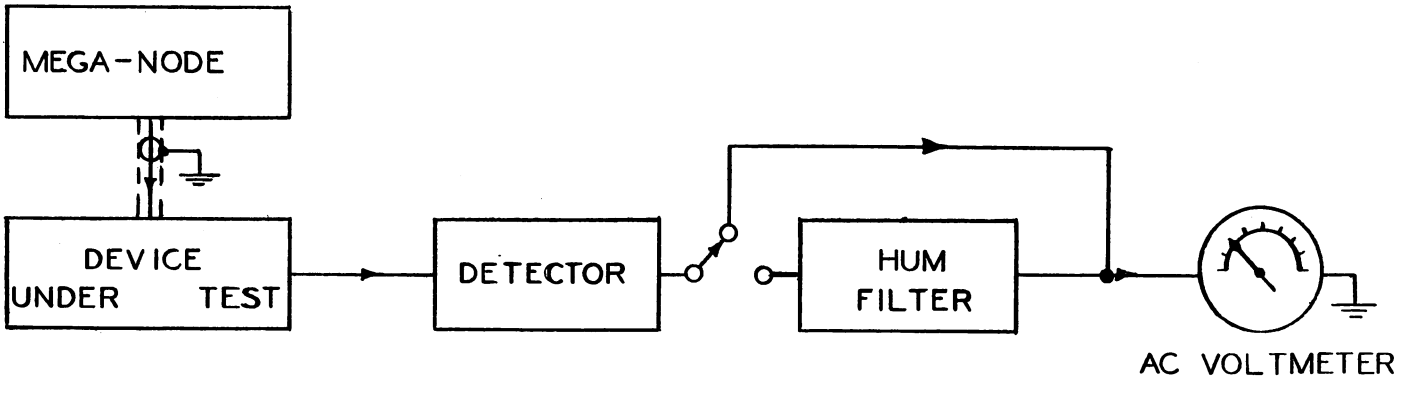


FIG. 4 - INTERCONNECTIONS FOR RELATIVE NOISE MEASUREMENTS

SECTION II
INSTALLATION

A. GENERAL.

The **MEGA-NODE** is designed for table top operation and thus presents no special installation problems. However, to insure optimum operation, the equipment should not be subjected to excessive moisture, vibration or temperature conditions.

B. PRELIMINARY CHECKS.

1. Connect the line plug to 117V (±10%), 60 cycle A.C. Turn power switch **ON**. Turn **OUTPUT LEVEL** control clockwise to increase diode filament current. Front panel meter should read up to full scale.

CAUTION: To lengthen life of tube, do not operate with large output for long periods of time.

C. INTERCONNECTION DATA.

The type of output measuring device and other auxiliary equipment employed will determine the method of interconnection. It is advised that before selecting a method of measurement, the sections on "Operation" and "Noise Measurement Theory" first be reviewed. (Sections III & IV.)

1. To connect the **MEGA-NODE** to the equipment to be tested, use a short piece of transmission line whose impedance equals the impedance with which the equipment was designed to operate. This line should be as short as possible and connected to the **MEGA-NODE** with the proper connector fitting. Three fittings are supplied with the instrument to handle all types of transmission line:

a. The coaxial ground fitting, connected to the panel with a length of bead chain, is used to ground the center conductor of the lower BNC UG-290/U panel fitting. The upper BNC UG-290/U panel fitting is then used to connect coaxial transmission line to the unbalanced impedances, 50, 75, 150, and 300 ohms.

b. The unbalanced adapter fitting (the adapter fitting with the grounding skirt on the lower terminal) is used to connect the twin lead transmission line from an unbalanced receiver or amplifier input. Impedance values available are the same 50, 75, 150, and 300 ohms.

c. The balanced adapter fitting is used to connect to twin lead transmission line from a balanced receiver or amplifier input. The impedances available are 100, 150, 300 and 600 ohms. Two BNC coaxial (using no adapter) may also be used.

SECTION III
OPERATION

A NOISE FIGURE MEASUREMENT.

1. **METHOD USING CALIBRATED POWER LEVEL METER.**

a. Connect **MEGA-NODE** to input of unit under test as shown in *figure 2*. Set impedance switch to the correct value. Connect a suitable indicator to the output of the unit under test.

b. Turn the **MEGA-NODE** on and advance the **OUTPUT LEVEL** control until the output indicator meter reads well up on the scale, then adjust the **TUNING** knob for maximum output reading. This knob resonates the reactance of the plate circuit of the noise diode and also that across the output terminals of the **MEGA-NODE**. Generally the tuning peak will be broad on all positions of the impedance switch except at infinity.

c. Turn the **MEGA-NODE** off, and read the output meter. Then turn the **MEGA-NODE** on and advance its **OUTPUT LEVEL** control until the output indicator meter shows that the output power of the unit under test has been doubled. The noise figure of the unit is then read directly from the **MEGA-NODE** meter scale, adding impedance level corrections as given on the panel.

2. **METHOD USING FIXED PAD AND AC VOLTMETER.**

This method is employed when a power level indicating device is not available. In this case, any A.C. voltage indicating device may be used; the accuracy of calibration of the device is insignificant. The equipment should be connected as shown in *figure 3*.

a. With the fixed pad switched out of the circuit (0 db attenuation), the **MEGA-NODE**

switch off, adjust the gain of the auxiliary amplifier so that the internal noise generated in the device under test provides a deflection on the A.C. voltmeter. Note this meter indication.

b. Switch in the 3 db pad; place the **MEGA-NODE** power switch in the **ON** position; advance the **OUTPUT LEVEL** control until the same output meter reading is obtained. The noise figure of the equipment under test is then read directly in db from the **MEGA-NODE** meter scale, adding the proper correction factor for impedance level as given on the panel. This procedure also doubles the noise output power of the device under test.

3. **RELATIVE MEASUREMENTS.** Where the actual noise figure measurement is not required and relative indications of noise values will suffice, the following method may be employed *(see figure 4)*:

a. With the equipment connected as shown in *figure 4*, adjust the auxiliary amplifier gain so that the internal noise generated in the device under test results in a deflection on the A.C. meter. Note this reading.

b. Place the **MEGA-NODE** power switch in the **ON** position; place the meter switch in the **READ METER SCALE** position. Advance the **OUTPUT LEVEL** control for an increase in the A.C. voltmeter reading. Note the new A.C. voltmeter reading. The indication on the **MEGA-NODE** is then a relative indication.

4. **LOG-LOG GRAPHICAL METHOD OF EVALUATING NOISE FIGURE.** This method is applicable where the noise figure of the device under test is comparable in value to that corresponding to the maximum output capabilities of the **MEGA-NODE**. It is also useful in those cases where neither a r-f voltmeter or power meter *(fig. 2)* nor a 3 db attenuator pad *(fig. 3)* is readily available. It involves the use of the output voltage developed by the second detector of the equipment under test (provided the detector is of the diode type) as the measured quantity, thus permitting the use of a D.C. type of V.T.V.M. such as is commonly available in most laboratories. The set-up of equipment is similar to that shown in *figure 4* with the exception that the V.T.V.M. (connected across the diode detector load resistor) replaces the hum filter and A.C. voltmeter shown.

The procedure is best explained by means of an illustrative example, and the various steps are given below:

a. Set up the equipment as discussed above.

b. With the **MEGA-NODE** off and with the amplifier tube just preceding the second detector removed, measure the residual D.C. voltage across the detector load resistor. This voltage is caused by a combination of "contact potential" and electron initial emission velocities, and its value is to be subtracted from all subsequent voltage readings prior to plotting them. Let us say this voltage reading is 0.3 volts.

c. Replace the amplifier tube removed above, and, with the **MEGA-NODE** still off and with amplification of at least 80 db provided as discussed in Section IV, C, read the developed detector voltage. This reading should be at least double the previous "residual" reading if the amplification value noted above has been met. Let us say the voltage reading for this step is 0.7 volts.

d. With the **MEGA-NODE** on, turn its **OUTPUT LEVEL** control up to give a noise diode D.C. plate current of 40 ma. Next, adjust the **TUNING** knob of the **MEGA-NODE** for maximum 2nd detector output as read on the V.T.V.M. Let us say this maximum output voltage measures 1.3 volts.

e. Turn the **OUTPUT LEVEL** control down to give a noise diode D.C. plate current of 20 ma. and read the 2nd detector V.T.V.M. Let us say this reading is 1.0 volt.

f. Subtract the 0.3 volt "residual" reading of step *b* from each of the subsequent readings, steps *c*, *d*, and *e*. This gives readings of 0.4, 0.7 and 1.0 volts respectively.

g. Using log-log graph paper with **MEGA-NODE** current as the abscissa and 2nd detector voltage as the ordinate, plot a horizontal line at the 0.4 volt level as a reference base line, and plot the 0.7 volt, 20 ma. point and the 1.0 volt, 40 ma. point as shown at A and B respectively of *figure 5*.

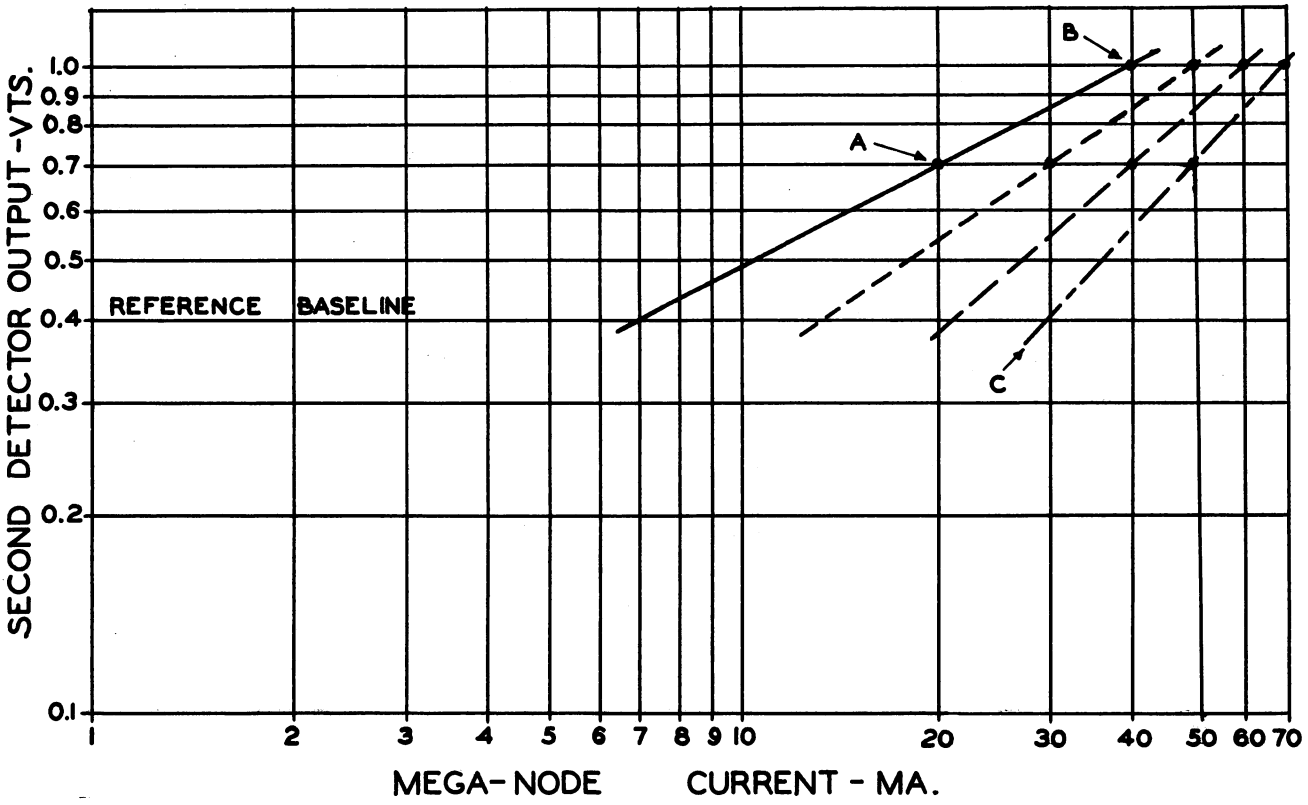


Figure 5, Log-Log Graphical Noise Measurement.

h. The problem now is to find by graphical trial-and-error, an incremental noise diode current value. When this value is added equally to points A and B, it will yield a new pair of points. A straight line through this pair of points then intersects the REFERENCE BASE LINE at a current value exactly equal to the incremental current value.

i. Let us first try an incremental current value of 10 ma. When this value is added equally to points A and B we get two new points, 0.7 volt, 30 ma. and 1.0 volt 50 ma. A straight line drawn between these points (the short dashed line in *figure 5*) intersects the REFERENCE BASE LINE at about 13.4 ma., which is larger than the chosen incremental value. This indicates that a larger incremental value should be tried.

j. Trying an increment of 20 ma., we get points 0.7 volt, 40 ma. and 1.0 volt, 60 ma. A straight line through these points (the long dashed line in *figure 5*) produces an intercept at about 21.5 ma. A still larger incremental value must hence be chosen.

k. Trying an increment of 29 ma., we get points 0.7 volt, 49 ma. and 1.0 volt, 69 ma. A straight line thro igh these points (the long-short dashed line in *figure 5*) intersects the REFERENCE BASE LINE at exactly 29 ma., corresponding to the incremental value chosen. This is the correct value of noise diode current to use in calculating the noise figure of the device under test. At the same time, the slope of the final plotted line gives directly the rectifier power law of the second detector used in the set-up when it is noted that this final line is essentially that of rectified detector output voltage versus total noise power applied to the detector. A 45 degree slope (i.e., tan = 1) would thus indicate that the detector was of the so-called "square law" type, while a 26.6 degree slope (i.e., tan = 0.5) would indicate a linear detector.

B. MEASUREMENT OF INPUT RESISTANCE.

Although the Kay Electric Company recommends the use of its *Mega-Match* frequency-scanning VHF Impedance Meter for measuring impedances, an approximate evaluation of the integrated input resistance of an equipment may be made by the use of the **MEGA-NODE** (see Section IV). This method consists essentially of a procedure for comparing the input resistance of the device under test with one or more of the output resistance positions of the **MEGA-NODE**. Several precautions must be observed in applying this method. First, the method does not yield information as to the input impedance-versus-frequency characteristics of the equipment being measured, but instead gives an effective "integrated" resistance value which is a function of the selectivity characteristic of the apparatus. The method is therefore useful only when the input impedance of the device is purely resistive and of constant magnitude over the frequency band being passed by the apparatus under test. A second precaution is that the input terminals of the equipment being measured should be connected directly across the output terminals of the **MEGA-NODE** to make this method completely valid. Otherwise, the connecting leads will cause an impedance transformation effect to take place which will result in an error in measurement. The only exception to this is when the connecting leads constitute a loss-less transmission line of characteristic impedance exactly equal to the input resistance of the equipment being measured. Once such a transmission line is found, the input resistance of the device under test is automatically known.

SECTION IV
TECHNIQUE OF MEASUREMENT

A. THE OUTPUT METER.

1. For Noise Figure measurements (Section V, "Theory of Operation", equations 4 & 5), the relative noise power output of the equipment under test must be evaluated. The output meter must, therefore, be a device capable of indicating random noise power RATIOS. For best accuracy it is desirable to use a meter responding to rms voltage or current values. Linearity of the indicator and of auxiliary equipment may be determined by first introducing, with the **MEGA-NODE**, a noise input level known to be considerable (i.e., at least 8 db) higher than the internal noise level of the unit under test and then doubling the noise diode D.C. plate current, thus doubling (i.e., increasing by 3 db) the input noise power. The resultant change in deflection of the output indicating device is then a measure of the 3 db change in noise power output from the equipment under test. This calibration should be performed with gain of the system reduced to that point wherein the operating level of the output indicating device is the same as for the ensuing Noise Figure measurement.

2. Almost any indicating device may be used following the detector, provided that an insertion loss pad of 0 db and 3 db be made available for use just ahead of the detector. The pad is first set at 0 db for the condition of no noise input being derived from the **MEGA-NODE**, and the output indication is noted. The 3 db section is then inserted and the noise signal from the **MEGA-NODE** is turned up to provide the same output reading as before. The noise figure of the equipment under test is then read directly in db from the **MEGA-NODE** meter scale, adding the proper correction factor for impedance level as given on the panel. In using the pad described above, care must be taken that its insertion does not affect the bandpass or gain characteristic of the unit under test. A meter directly across the output of the IF amplifier may be used as the indicating device provided the meter is substantially flat to above the IF frequency and reads rms values.

B. HUM CONSIDERATIONS.

It is important that the output indication corresponds to random noise rather than to hum. A convenient method for checking this is to short circuit the output of the last tube which contributes significant noise to the system. The output indication should fall to zero. This test will not account for hum components introduced prior to the short circuit. However, such hum components are normally small enough not to affect the measurement. Their presence, if suspected, may be determined by the temporary introduction of additional filtering or the observation of the noise output on a high gain oscilloscope. The use of bridge type hum filters, 60 cycle and 120 cycle, may be desirable and helpful.

C. CONDITIONS OF MEASUREMENT.

1. The reactive component of the receiver input impedance should be tuned out for accurate Noise Figure measurements. This condition is satisfied by the proper adjustment of the **TUNING** control of the **MEGA-NODE.** However, if the IF amplifier following the front end under test is broad-band it will probably be difficult to cancel the receiver input reactance over the total bandwidth, particularly if the input circuit of the receiver is of the variably tuned type. It may be necessary to replace the broad-band IF amplifier with a narrow-band amplifier. The Noise Figure may then be measured at a number of frequencies in the RF pass-band and the results plotted to give the overall noise picture.

2. All stages prior to the indicator must be linear and overload must not occur with even the highest noise input it may be necessary to employ.

3. There must be sufficient overall gain in the Noise Figure measurement set-up to produce across the terminals of the output indicating device enough energy attributable to the effective input noise sources in the device under test to give a usable output reading or deflection. For overall bandwidths of the order of 4 mc. this will generally require at least 80 db of overall gain.

SECTION V
THEORY OF OPERATION

A. NOISE MEASUREMENT THEORY.

The "noise diode" method of measuring receiver Noise Figures is quite fundamental and permits simplification in procedure and greater accuracy than other methods. Techniques employing a continuous-wave signal generator are subject to a noticeable error in the measurement of the extremely small power levels employed, especially at the higher frequencies, and a separate measurement of receiver bandwidth is required. The use of a temperature-limited diode as a noise generator permits cancellation of the bandwidths involved, since the diode noise is distributed the same as the receiver noise with respect to frequency. This method, hence, requires no measurements nor knowledge of bandwidth or gain. The mean squared noise current supplied by the diode is proportional to the d-c plate current which can be easily and accurately measured.

1. **NOISE FIGURE MEASUREMENTS.** Any receiver, other than a hypothetical ideal receiver, will have noise generated within the receiver itself in addition to the noise supplied by the signal source. The Noise Figure is a figure of merit by which the noise of a given receiver system is compared with that of an ideal receiver in a similar system but having the same bandwidth. The noise supplied to the ideal receiver by the signal source will be

$$e_t^2 = 4KTR_a\Delta f \qquad (1)$$

Where:

e_t^2 = Open-circuited mean squared thermal noise voltage.

K = Boltzmann's constant, 1.37×10^{-23} joules/°K.

T = Temperature of resistance in °K.

R_a = Internal resistance of the source in Ω.

Δf = Receiver noise bandwidth in cps.

The noise present in the given receiver will be that supplied by the signal source plus the noise generated within the receiver itself. The noise generated within the receiver may be referred to the signal source as a mean squared noise voltage. Call this voltage e_n^2.

Then by definition:

$$\text{Noise Figure} = F = \frac{e_n^2}{e_t^2} \qquad (2)$$

To determine e_n^2 the "noise diode" is connected to the receiver through the signal source impedance, R_a. With the noise source turned off, the noise power output of the receiver is measured. Then the noise source is turned on and the diode direct plate current is increased from its lowest value to that value which just doubles the receiver noise power output. The mean squared noise current of the diode is given by

$$i^2 = 2eI_b\Delta f \qquad (3)$$

Where:

i = Root mean squared noise current in amps.
e = Charge on electron (1.59×10^{-19} coulombs).
I_b = DC diode plate current in amperes.
Δf = The noise bandwidth of the receiver in cps.

The mean squared voltage developed by this noise current across the internal impedance of the source (R_a) will be

$$e_n^2 = (iR_a)^2 = 2eI_b \Delta f R_a^2 \qquad (4)$$

Substituting equations (1) and (4) in equation (2)

$$F = \frac{eI_bR_a}{2KT} \qquad (5)$$

It is usually permissible to assume T to be room temperature; i.e., 288° Kelvin, 17°C., 63°F., in which case equation (5) reduces to:

$$F = 20I_bR_a \qquad (6)$$

Variation of this reference temperature between 270°K and 300°K ordinarily will affect the Noise Figure by less than about ±5%, which is equivalent to ±0.2 db. The value of F given by (6) is a power ratio. It may be expressed in db by the relationship:

$$F_{db} = 10 \log_{10} F \qquad (7)$$

2. REQUIREMENTS OF THE NOISE DIODE GENERATOR.

a. Resistor R_a, which is taken as the internal impedance of the signal source, must be constant over the noise bandwidth of the unit under test.

b. The "Noise Diode" must be fully temperature limited. This is a condition of equation (3) and it is well to observe that the a-c plate resistance of the diode, which shunts R_a, is sufficiently high to be negligible only when the diode is completely temperature limited. This condition is met in the **MEGA-NODE** for all values of diode d-c plate current less than 50 ma.

B. REFERENCES.

1. D.O. North, "The Absolute Sensitivity of Radio Receivers", RCA Review, vol. 6, pp, 332–344; January, 1942.

2. H.T. Friis, "Noise Figures of Radio Receivers", PROC. IRE, vol. 32, pp. 419–422; July, 1944.

3. P.G. Sulzer, "Noise Generator for Receiver Measurements", Electronics, vol. 21-7, pp 96–98; July 1948.

4. H. Goldberg, "Some Notes on Noise Figures", PROC. IRE., vol. 36, pp. 1205–1214; October 1948. Reference is made in particular to pp. 1210 and 1211.

5. De Witt and Stodola, "Detection of Radio Signals Reflected from the Moon", PROC. IRE., vol. 37, pp. 229–241; March 1949. Reference is made in particular to pp. 235 and 236.

SECTION VI
DETAILED METHOD OF NOISE FIGURE MEASUREMENT ON TELEVISION RECEIVERS

A. MEASUREMENT TECHNIQUE.

In order to use the **MEGA-NODE**, it is necessary to read the output power of the system. This cannot be done with a peak or average reading instrument even though it is calibrated .707 peak and called an rms meter. Because power is directly proportional to the mean square voltage, a thermal type indicator is the best output measuring device. In the case of a television receiver, the noise power is conveniently measured at the output of the IF amplifier before the signal has been detected. An instrument well suited for this work is a sensitive bolometer. Although noise figure measurement of the tuner alone is desired, it is necessary to raise the noise power output level for purposes of measurement. This can be done most nearly approximating conditions of tuner operation by using a television IF amplifier. To avoid obscuring the noise measurement of the front end the IF amplifier should be relatively free of noise and regeneration. Setting of the FINE tuning control may also vary the noise figure to a slight degree. For purposes of standardization, the tuner should be adjusted to the center of the television channel using a sweep signal generator.

Actual measurement is made with the instruments arranged as shown.

1. Apply operating voltages to all units.

2. With a sweep signal generator, set the tuner at the center of the channel.

3. Set the output control of the **MEGA-NODE** at minimum (full counterclockwise), and select the proper source resistance (usually 300 ohms balanced).

4. Adjust the bolometer unit to measure output noise power; turn off the **MEGA-NODE**.

5. Read noise output power.

6. Turn on the **MEGA-NODE** and increase the output level until the power indication of the bolometer is exactly doubled. Turn off the **MEGA-NODE** to check the original noise power and, if necessary, recheck the zero of the bolometer. When "turning on" the **MEGA-NODE** just doubles the bolometer reading, the noise figure may be read from the **MEGA-NODE** directly in decibels. This reading must be corrected by adding the number of decibels indicated at the "impedance" control for balanced or unbalanced operation. Check the meter-scale knob position and add 10 db if necessary.

B. PRECAUTIONS FOR ACCURACY.

In order to insure accuracy of measurements on high gain systems it is necessary to observe several precautions:

1. **FEED-BACK.** There must be no feed-back in the system not present under normal operating conditions. The barreter for the bolometer bridge should be placed very close to the last amplifier tube in the IF strip, and connection to the bridge from the barreter should be made with shielded cable. Shielding should be as effective as possible.

2. **PICKUP.** Since the system to be measured has extremely high gain, the presence of any high-frequency fields, particularly those of nearby television stations, can cause inaccuracy. In order to reduce this possibility, measurement should be made in a screen-room. If this is impossible, the output should be checked carefully to make certain that only thermal noise is present.

3. **BIAS AND AUTOMATIC VOLUME CONTROL.** The automatic biasing controls of the tuner and IF amplifier should be disabled. Normal bias present at zero signal input (for purposes of standardization) should be applied to the tubes from a battery supply. Bias supplies operating from power lines are not desirable because of likelihood of high noise voltages and the possibility of pickup and hum.

4. **HUM.** Introduction of hum in the system can completely mask noise voltages and must be avoided. This is aided by a coupling network with poor low frequency response used to supply power to the barreter.

5. **SERIES LEAD REACTANCE.** It has been found that the unavoidable series lead reactance present between the terminating resistors and panel connectors will affect the position of the tuning switch when operating at impedance levels below 300 ohms. The panel markings TUNING, MC are correct for 300 ohms, the

usual television antenna impedance. (White balanced and red unbalanced). However, to obtain minimum S.W.R. it is necessary to adjust the tuning switch to a different position for the same operating frequency at other impedance levels (for example, 50 ohm unbalanced). The table below gives the correct tuning switch positions.

6. IF AMPLIFIER NOISE. While the usual Tuners and IF amplifiers associated with television receivers will not give trouble from this cause, it is possible for an extremely noisy IF amplifier to control the noise-figure of the system, rather than the tuner. This can be quickly checked by measuring the output noise with the **MEGA-NODE** turned off; then remove plate voltage from all tubes in the tuner, still allowing the IF amplifier to function. The noise power under these conditions should be very much smaller than the normal operating noise output of the system.

7. LIMITING. A check should be made to ascertain that the noise is not limited by overloading of the IF amplifier. Operation in the linear region is essential for accurate measurements.

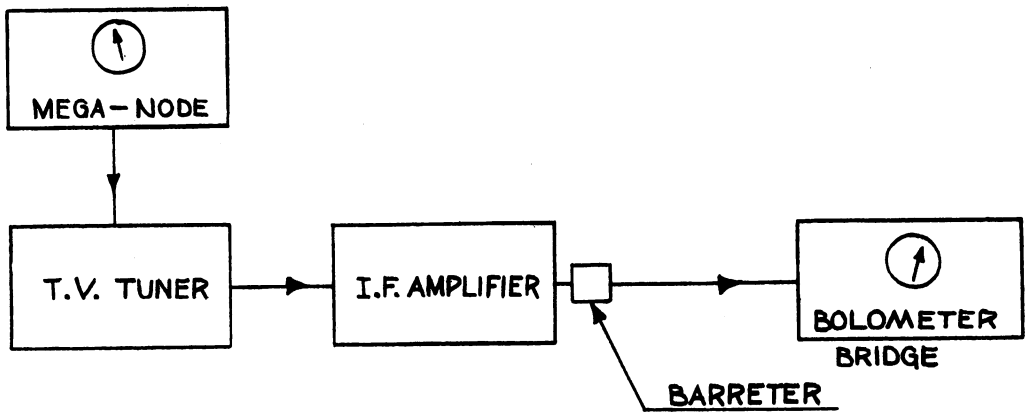
8. AC-DC TUNERS. A line isolating transformer should be used for tests of AC-DC equipment.

IMPEDANCE LEVEL AND CONNECTION					
Desired Operating Frequency Megacycles	50 unbal. Read Red Marking Set Switch To	75 unbal. Read Red Marking Set Switch To	150 unbal. Read Red Marking Set Switch To	150 bal. Read White Marking Set Switch To	300 ohms all Positions
5-30	5-30	5-30	5-30	8-35	Marking On Front Panel is Correct
30-50	30-50	30-50	30-50	8-35	
50-72	30-50	30-50	30-50	35-60	
72-88	50-72	50-72	50-72	35-60	
88-108	50-72	72-88	50-72	60-85	
108-130	50-72	72-88	72-88	60-85	
130-150	50-72	88-108	88-108	85-115	
150-170	72-88	88-108	88-108	85-115	
170-192	72-88	108-130	108-130	85-115	
192-220	88-108	108-130	108-130	115-140	

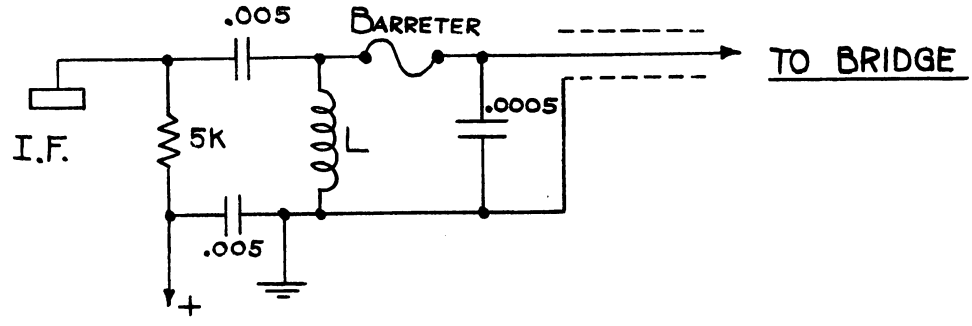
figure 6

NOISE FIGURE MEASUREMENT

BLOCK DIAGRAM



BARRETER SCHEMATIC



"L" RESONATES I.F. WITH STRAY CAPACITANCE
NOT CRITICAL

SECTION VII
MAINTENANCE

A. INTERNAL ADJUSTMENTS.

The following chassis adjustments, although factory-set, may require attention after diode aging, component replacement, etc. The following procedure should be used in setting these controls.

1. **Preset High** *(R-3)*. This control should be set to provide a slightly more than full-scale reading on the panel meter when the **COARSE** and **FINE OUTPUT LEVEL** control adjustments are fully clockwise and the **OUTPUT INDICATOR** switch is in the **ADD 10 DB** position.

2. **Preset Low** *(R-6)*. This control should be adjusted with the **OUTPUT INDICATOR** switch *(S-2)* in the **NORMAL** position. Adjust *R-6* for a slightly more than full-scale panel meter deflection when the **COARSE** and **FINE OUTPUT LEVEL** control adjustments are fully clockwise.

3. **Meter Multiplier Adjustment** *(R-18)*. This control is initially factory-set (and soldered in place) for the correct meter calibration. Should any component in the meter circuit be replaced, unsolder and reset *R-18* for the correct meter calibration in the **ADD 10 DB** position. An external 0-50 ma, DC meter should be connected in series with the plate supply to the noise diode; the panel meter may be calibrated using the external meter as a standard.

SECTION VIII
PARTS LIST

A. MODEL 240A, *Dwg. No. KB-1558-E*

RESISTORS: (UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ARE FIXED, ½ WATT, COMPOSITION, 10% TOLERANCE RESISTORS.)

R-1	360; 2W	R-6	300; 1W	R-11	5; ADD 10 DB	R-16	300
R-2	360; 2W	R-7	750; 25W POT OUTPUT LEVEL	R-12	300	R-17	150
R-3	60; 2W POT TYPE J; FINE TUNING	R-8	10	R-13	150	R-18	75
R-4	360; 2W	R-9	10	R-14	75	R-19	50
R-5	360; 2W	R-10	100	R-15	50	R-20	150

CAPACITORS:

C-1	A & B; 20μF; 150V;
C-2	2000μF; 15V
C-3	0.01μF; 600V
C-4	0.01μF; 600V
C-5	500μμF; 500V; MICA
C-6	500μμF; 500V; MICA
C-7	NOT USED
C-8	1000μμF; 500V; CERAMIC

SWITCHES:

S-1	SPST; ON-OFF LINE
S-2	A & B; SPECIAL ROTARY SWITCH; ADD 10 DB
S-3	A & B; SPECIAL ROTARY SWITCH; ADD DB TO METER SCALE
S-4	SPECIAL ROTARY SWITCH; OHMS; TUNING MC

MISCELLANEOUS:

L-1	SPECIAL BIFILAR CHOKE COIL
L-2	SPECIAL BIFILAR CHOKE COIL
L-3	THRU L-10 SPECIAL COILS
D-1	THRU D-4 FEDERAL SELENIUM RECTIFIER; 139C1AX1
D-5	THRU D-8 FEDERAL SELENIUM RECTIFIER; 1002A; 65 179/24
F-1	FUSE; 1 AMP. 250V
J-1	625/U OUTPUT JACK
J-2	625/U OUTPUT JACK
I-1	PILOT LAMP; G.E. #44; 6.3 VOLTS
M-1	METER; SPECIAL
P-1	117V. AC PLUG
T-1	SOLA #30804 REGULATING TRANSFORMER (ADD 10 DB TO READ METER)
T-2	SPECIAL FILAMENT TRANSFORMER
V-1	TUBE; #5722

B. MODEL 240B, *Dwg. No. KB-5511-A.*

RESISTORS: (UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ARE FIXED, ½ WATT, COMPOSITION, 10% TOLERANCE RESISTORS.)

R-1	750; 20W; POT COARSE	R-7	1.5K; 2W	R-13	51
R-2	60; 2W POT FINE	R-8	100K	R-14	300
R-3	500; 2W; POT HIGH ADJ. (INT.)	R-9	150	R-15	150
R-4	360; 2W	R-10	300	R-16	75
R-5	100; 10W	R-11	150	R-17	51
R-6	1K; 2W; POT LOW ADJ. (INT.)	R-12	75	R-18	5; METER SHUNT VARIABLE (INT.) ADD 10 DB

CAPACITORS:

C-1	20μF; 450V
C-2	20μF; 450V
C-3	500μμF; 500V; MICA
C-4	500μμF; 500V; MICA
C-5	1000μμF; 600V; MOLDED DISC
C-6	0.01μF; FEED THRU
C-7	0.01μF; FEED THRU
C-8	2000μF; ELECTROLYTIC

SWITCHES:

S-1	SPST; ON-OFF
S-2	A, B & C; SPECIAL ROTARY SWITCH; NORMAL-STANDBY ADD 10 DB
S-3	SPECIAL ROTARY SWITCH; ADD 10 DB TO METER SCALE
S-4	SPECIAL ROTARY SWITCH; TUNING, MC

MISCELLANEOUS:

D-1	RECTIFIER; SIEMENS SSF B125 C125
D-2	A & B 25S1C1S1G; RECTIFIER, RADIO RECEPTER
F-1	FUSE; 3AG; 1 AMP; 250V
J-1	JACK; BNC TYPE; OUTPUT
J-2	JACK; BNC TYPE; OUTPUT
J-3	SOCKET
L-1	SPECIAL COIL
L-2	SPECIAL FILAMENT RF CHOKE
L-3	THRU L-10 SPECIAL COILS
I-1	PILOT LAMP, G.E. NE 51
M-1	METER; SPECIAL
T-1	TRANSFORMER; SOLA 20-13-060
T-2	TRANSFORMER; SPECIAL; SNC P2393
V-1	5722 TUBE
P-1	PLUG; 117V; AC; POWER SUPPLY
P-2	PLUG

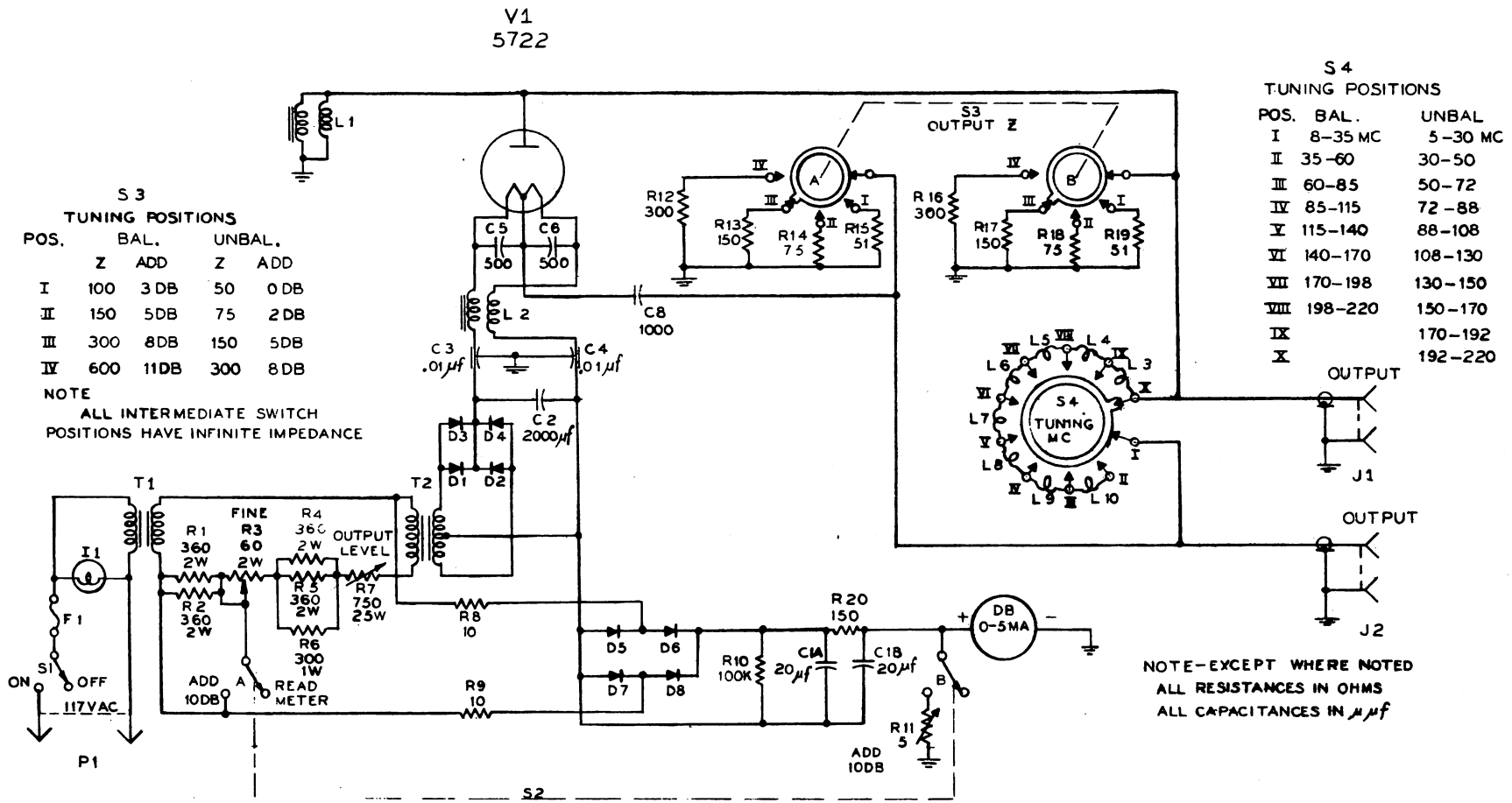
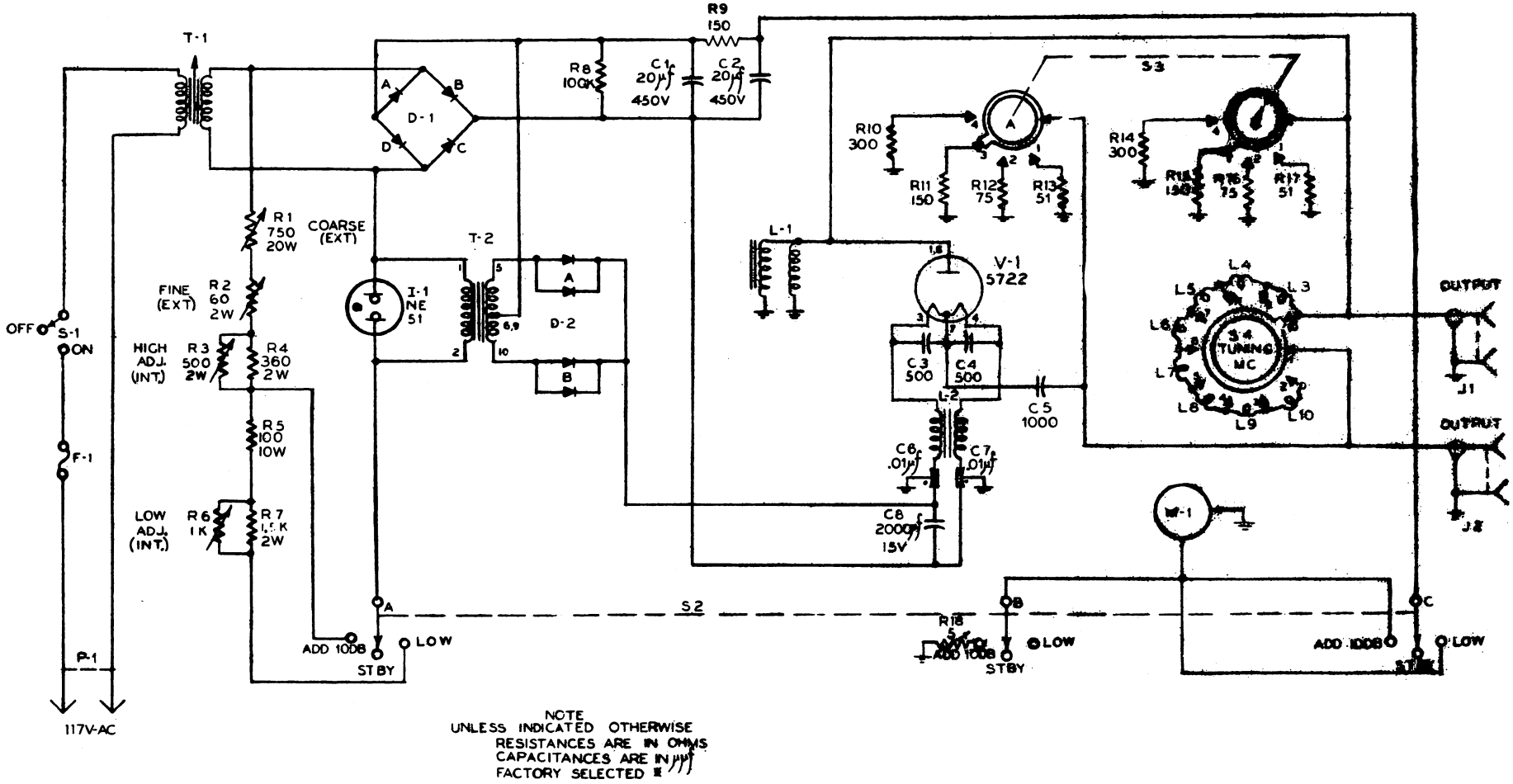


Figure 7. Model 240A Schematic, KB 1558-E



NOTE
UNLESS INDICATED OTHERWISE
RESISTANCES ARE IN OHMS
CAPACITANCES ARE IN μμf
FACTORY SELECTED ※

Figure 8, Model 240B Schematic, KB 5511-A

MEGA-NODE

ADDENDUM

REFERENCE	CHANGE
Page 2	Add new figures 2, 3 & 4, block diagrams of equipment interconnections.
Page 4, column 1 & 2, Section A, item 4.	The Hum Filter as referenced here and elsewhere in the manual, is an optional item. The filter may, or may not be required, depending on the requirements of the associated equipment, and considerations discussed in Section B, column 2, page 6.

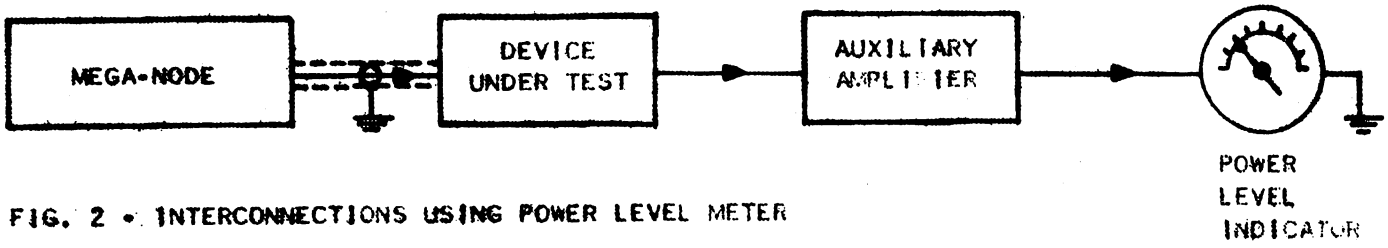


FIG. 2 - INTERCONNECTIONS USING POWER LEVEL METER

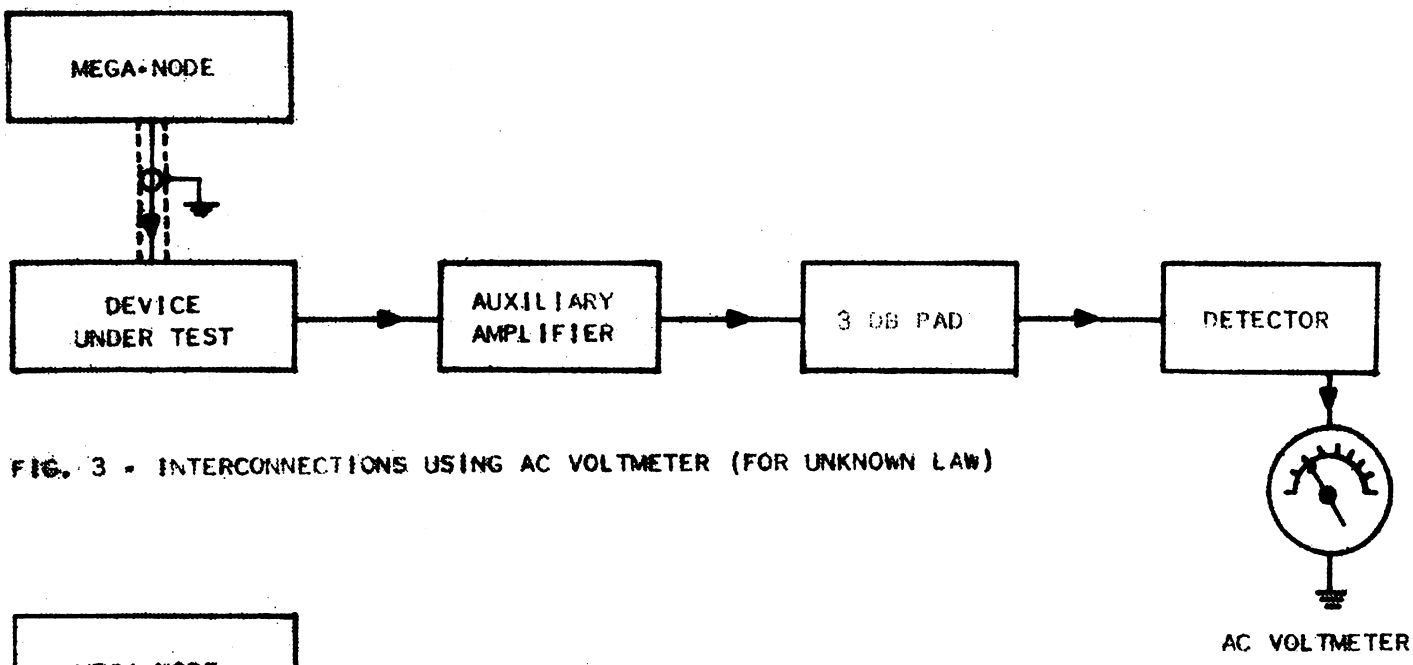


FIG. 3 - INTERCONNECTIONS USING AC VOLTMETER (FOR UNKNOWN LAW)

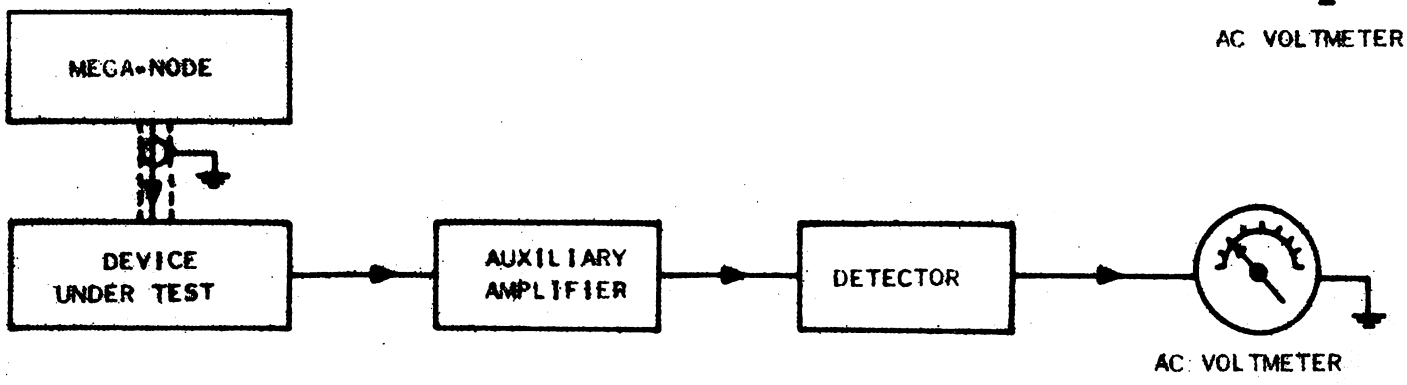


FIG. 4 - INTERCONNECTIONS FOR RELATIVE NOISE MEASUREMENTS